

CLAIMS

We claim:

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1. A method in a wearable computer for providing information about a current state of a user of the wearable computer, the current state modeled with multiple state attributes, the wearable computer executing a plurality of state server modules (SSMs) to supply values for the state attributes, executing a plurality of state client modules (SCMs) to receive and process values for the state attributes, and executing an intermediary module to facilitate exchange of state attribute values, comprising:

- under control of each of the executing SSMs, sending to the intermediary module a registration message indicating a current availability of the SSM to supply values for at least one indicated state attribute;
- under control of each of the executing SCMs,
 - determining a need for a value of one of the state attributes; and
 - sending to the intermediary module a request for a value of the one state attribute; and
- under control of the intermediary module,
 - receiving the sent registration messages; and
 - for each of the executing SCMs,
 - receiving from the SCM the request for the value of the one state attribute;
 - determining based on the received registration messages multiple of the SSMs that are currently available to supply values for the one state attribute;
 - in response to the receiving of the request from the SCM, requesting the determined SSMs to supply the requested value;
 - receiving at least one value of the one state attribute in response to the requesting; and
 - sending to the SCM at least one of the received values,

26 so that the SCMs receive values for the state attributes as requested from available SSMs.

1 2. The method of claim 1 including, under the control of the
2 intermediary module:

3 receiving from a first of the SSMs a current value of the indicated state
4 attribute, the receiving not in response to a request of the first SSM for the current value;
5 and

6 in response to the received current value, supplying the received current
7 value to a first SCM.

1 3. The method of claim 2 wherein at least some of the SCMs send
2 registration messages to the intermediary module, each registration message indicating a
3 current desire to receive values for an indicated one of the state attributes, and including
4 determining that the first SCM is to receive the received current value based on a
5 registration message previously received from the first SCM.

1 4. The method of claim 1 wherein the intermediary module stores
2 values for the state attributes that are received from the SSMs, and wherein the requesting
3 of determined SSMs to supply a requested value to be sent to a SCM occurs only if an
4 appropriate value for the indicated state attribute is not stored by the intermediary
5 module.

1 5. The method of claim 1 wherein the sending of a received value to an
2 SCM includes an indication of the SSM from which the sent value was received.

1 6. The method of claim 1 including, under the control of each of the
2 determined SSMs:

3 receiving the request from the intermediary module to supply the requested
4 value;

determining at least one input sensor able to supply input information related to the requested value; and
in response to the receiving of the request,
obtaining the related input information from the determined input sensors;
generating the requested value based on the obtained information; and
sending to the intermediary module the generated value.

7. The method of claim 1 including, under the control of a first of the SCMs:

- receiving a sent value from the intermediary module; and
- presenting information to a user of the first state client module based on the receiving of the value.

8. The method of claim 1 wherein at least some of the SCMs send to the intermediary module requests for values of additional state attributes of a current state other than for the user, and wherein the intermediary module sends values for the additional state attributes to those SCMs, the values for the additional state attributes received from SCMs in response to requests for the values from the intermediary module.

9. A method in a computer for providing information about a current state that is modeled with multiple state attributes, comprising:

- receiving from a first source an indication of an ability to supply values for an indicated one of the state attributes of the modeled current state;
- receiving from a second source an indication of an ability to supply values for another of the state attributes of the modeled current state; and
- in response to receiving a request from a first client for a value of the indicated one attribute,
 - determining that the first source is available to supply the value;
 - obtaining the value from the first source; and

11 supplying a value obtained from the first source to the first client.

1 10. The method of claim 9 wherein the obtaining of the value for the one
2 attribute from the first source includes receiving descriptive information about the
3 obtained value.

1 11. The method of claim 10 wherein the supplying of the obtained value
2 to the first client includes supplying the descriptive information to the first client.

1 12. The method of claim 9 wherein the supplying of the obtained value
2 to the first client includes supplying an indication of the first source.

1 13. The method of claim 9 wherein the received request from the first
2 client additionally includes an indication of a source for the values of the one attribute,
3 and wherein the supplying of the obtained value to the first client occurs only if the first
4 source is the indicated source.

1 14. The method of claim 9 including, before supplying the obtained
2 value to the first client:

3 determining whether the obtained value satisfies a criteria for values
4 supplied to the first client; and

5 when it is determined that the obtained value does not satisfy the criteria,
6 requesting at least one source to supply a value for the one attribute
7 that satisfies the criteria;

8 receiving in response to the requesting at least one additional value for
9 the one attribute that satisfies the criteria; and

10 supplying to the first client a value for the one attribute based on the
11 received additional values.

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1 15. The method of claim 14 wherein the criteria is based on recency of
2 the value.

1 16. The method of claim 9 including storing values for attributes that are
2 received from sources so that the stored values can be later supplied to clients.

1 17. The method of claim 9 wherein the one attribute represents
2 information about a user of the computer.

1 18. The method of claim 17 wherein the represented information reflects
2 a modeled mental state of the user.

1 19. The method of claim 9 wherein the one attribute represents a current
2 prediction about a future state.

1 20. The method of claim 9 wherein the one attribute represents
2 information about the computer.

1 21. The method of claim 9 wherein the one attribute represents
2 information about a physical environment.

1 22. The method of claim 9 wherein the one attribute represents
2 information about a cyber-environment of a user of the computer.

1 23. The method of claim 9 wherein the obtaining of the value from the
2 first source involves requesting the first source to supply the value, wherein the first
3 source includes a group of instructions to be executed to produce a value for the one
4 attribute, and including loading and executing the group of instructions in response to the

5 requesting of the first source to supply the value, the loading and executing so that the
6 first source can produce the requested value.

1 24. The method of claim 9 wherein the first client includes a group of
2 instructions to be executed to receive a value for the one attribute, and including loading
3 and executing the group of instructions in response to receiving of a value for the one
4 attribute from a source, the loading and executing before the receiving of the request from
5 the first client.

1 25. The method of claim 9 including receiving from the first client an
2 indication of a second of the state attributes and an indication that a source for a value for
3 the second state attribute is to be a same source as for the supplied value for the one
4 attribute, and selecting a value to be supplied to the first client for the second state
5 attribute that is received from the same source.

1 26. The method of claim 9 including, after receiving a request from the
2 first client for a value of a second indicated attribute and receiving a value from a source
3 for the second attribute, supplying to the first client the received value for the second
4 attribute.

1 27. The method of claim 26 wherein the received value for the second
2 attribute is from the first source.

1 28. The method of claim 9 including, after receiving a value for the one
2 attribute from a third source, supplying the received value to the first client.

1 29. The method of claim 9 including, after receiving a request from a
2 second client for a value of the another attribute and receiving a value from the second
3 source for the another attribute, supplying the received value to the second client.

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1 30. The method of claim 9 wherein the obtaining of the value from the
2 first source by the intermediary module involves requesting the first source to supply the
3 value and receiving the requested value in response, and wherein the received value from
4 the first source is based on input information related to the one attribute that is retrieved
5 by the first source in response to the requesting.

1 31. The method of claim 9 including:
2 receiving from a source a current value of a specified state attribute, the
3 receiving not in response to requesting the current value from the source; and
4 in response to the receiving of the current value,
5 determining at least one client having an interest in receiving values
6 for the specified state attribute; and
7 sending the received current value to each of the determined clients.

1 32. The method of claim 9 including supplying to the first client a
2 mediated value for the one attribute that is based on multiple received values for the one
3 attribute.

1 33. The method of claim 9 wherein receiving of the supplied value by
2 the first client prompts the first client to present information to a user of the first client.

1 34. The method of claim 9 including:
2 receiving from the first client an indication of a condition; and
3 when it is determined that the condition is satisfied, notifying the first
4 client.

1 35. The method of claim 34 wherein the condition relates to a specified
2 one of the state attributes having a specified value.

1 36. A computer-readable medium whose contents cause a computing
2 device to provide information about a current state that is modeled with multiple state
3 attributes, by:

4 receiving from a first source an indication of an ability to supply values for
5 an indicated one of the state attributes of the modeled current state; and

6 in response to receiving a request from a first client for a value of the
7 indicated one attribute,

8 determining that the first source is available to supply the value;

9 obtaining the value from the first source; and

10 supplying a value obtained from the first source to the first client.

1 37. The computer-readable medium of claim 36 wherein the computer-
2 readable medium is a memory of the computing device.

1 38. A computer-readable generated data signal transmitted via a
2 transmission medium, the generated data signal having encoded contents that cause a
3 computer system to provide information about a current state that is modeled with
4 multiple state attributes, by:

5 receiving from a first source an indication of an ability to supply values for
6 an indicated one of the state attributes of the modeled current state;

7 receiving from a second source an indication of an ability to supply values
8 for another of the state attributes of the modeled current state; and

9 in response to receiving a request from a first client for a value of the
10 indicated one attribute,

11 determining that the first source is available to supply the value;

12 obtaining the value from the first source; and

13 supplying a value obtained from the first source to the first client.

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1 39. A computing device for providing information about a current state
2 that is represented with multiple attributes, comprising:

3 an attribute mapping module that is capable of receiving from a first source
4 an indication of an ability to supply values for an indicated one of the attributes of the
5 current state and of receiving from a second source an indication of an ability to supply
6 values for another of the attributes of the current state;

7 an attribute value request module that is capable of receiving a request for a
8 value of the one attribute from a first client; and

9 an attribute value supplier module that is capable of, in response to the
10 receiving of the request, determining that the first source is available to supply the value,
11 requesting the value from the first source, and supplying to the first client a value
12 received from the first source.

1 40. The computing device of claim 39 wherein the attribute mapping
2 module, the attribute value request module, and the attribute value supplier module are
3 components of an intermediary module executing in memory.

1 41. The computing device of claim 39 further comprising multiple
2 sources and multiple clients executing in the memory.

1 42. A computing device for providing information about a current state
2 that is represented with multiple modeled attributes, comprising:

3 means for receiving from a first source an indication of an ability to supply
4 values for an indicated one of the modeled attributes of the current state and for receiving
5 from a second source an indication of an ability to supply values for another of the
6 modeled attributes of the current state; and

7 means for, in response to receiving a request from a first client for a value
8 of the indicated one attribute, determining that the first source is available to supply the

9 value, requesting the value from the first source, and supplying a value received from the
10 first source to the first client.

1 43. A method in a portable computer for providing information about a
2 context that is modeled with multiple context attributes, comprising:

3 receiving from each of multiple sources an indication of an ability to supply
4 values for at least one of the context attributes of the modeled context;

5 receiving from each of multiple clients an indication of a desire to receive
6 multiple values for one of the context attributes of the modeled context; and

7 for each of the multiple clients,
8 receiving multiple requests from the client for a value for the one
9 context attribute for which the client has indicated the desire to receive values; and

10 after the receiving of each of the multiple requests, retrieving the
11 requested value by,

12 determining whether any of the multiple sources currently have
13 an ability to supply values for the one context attribute for which the client has indicated
14 the desire to receive values;

15 when at least one of the multiple sources is determined to have
16 the ability, requesting each of the determined sources to supply a value for the one
17 context attribute;

18 receiving at least one value from the determined sources in
19 response to the requesting; and

20 sending at least one of the received values to the client.

1 44. The method of claim 43 including, after requesting each of the
2 determined sources to supply the value:

3 receiving from a first source an indication of an ability to supply values for
4 the first attribute, the first source not one of the multiple sources; and

5 after the receiving of a next request for a value of the first attribute,
6 requesting the first source to supply a value of the first attribute.

45. The method of claim 43 including, after requesting each of the determined sources to supply the value:

46. The method of claim 43 wherein the context attributes represent information about a user of the portable computer.

48. The method of claim 43 wherein the requesting of a first source to supply a value for the one context attribute prompts the first source to retrieve input information related to the one context attribute and to generate the value for the one context attribute based on the retrieved input information.

50. A computer-readable medium containing instructions that when executed cause a computing device to provide information about a context that is modeled with multiple context attributes, by:

for each of the multiple clients,
receiving multiple requests from the client for a value for the one context attribute for which the client has indicated the desire to receive values; and
after the receiving of each of the multiple requests, retrieving the requested value by,
determining whether any of the multiple sources currently have an ability to supply values for the one context attribute for which the client has indicated the desire to receive values;
when at least one of the multiple sources is determined to have the ability, requesting each of the determined sources to supply a value for the one context attribute;
receiving at least one value from the determined sources in response to the requesting; and
sending at least one of the received values to the client.

51. A portable computer for providing information about a context that is represented with multiple attributes, comprising:

an attribute mapping module that is capable of receiving from each of multiple sources an indication of an ability to supply values for at least one of the attributes of the context and of receiving from each of multiple clients an indication of a desire to receive multiple values for one of the attributes of the context; and

an attribute value supplier module that is capable of receiving from each of the multiple clients multiple requests for a value for the one attribute for which the client has indicated the desire to receive values, of determining after the receiving of each of the multiple requests whether any of the multiple sources currently have an ability to supply values for the one attribute, of requesting after the determining of at least one source that each determined source supply a value for the one attribute, of receiving in response to the requesting at least one value from the determined sources, and of sending after the receiving at least one of the received values to the requesting client.

1 52. A computer-implemented method for providing information about a
2 current state that is modeled with multiple state attributes, each of the state attributes
3 having multiple sources available to supply values for the attribute, comprising:

4 sending to an intermediary module a first request for a value of a first of the
5 state attributes;

6 receiving from the intermediary module a first value for the first state
7 attribute that was supplied from a first source, the first value obtained by the intermediary
8 module from the first source in response to the sent first request and sent from the
9 intermediary module in response to the sent first request;

10 sending to the intermediary module a second request for a value of the first
11 state attribute;

12 receiving from the intermediary module a second value for the first state
13 attribute that was supplied from a second source, the second value obtained by the
14 intermediary module from the second source in response to the sent second request and
15 sent from the intermediary module in response to the sent second request;

16 sending to the intermediary module a third request for a value of a second
17 of the state attributes;

18 receiving from the intermediary module a third value for the second state
19 attribute that was supplied from the first source, the third value obtained by the
20 intermediary module from the first source in response to the sent third request and sent
21 from the intermediary module in response to the sent third request; and

22 using at least one of the received values to perform processing based on the
23 modeled current state.

1 53. The method of claim 52 wherein the processing based on at least one
2 of the received values includes presenting information to a user.

1 54. The method of claim 52 wherein the state attributes represent
2 information about a user of the computer.

1 55. A computer-readable medium whose contents cause a computing
2 device to provide information about a current state that is modeled with multiple state
3 attributes, each of the state attributes having multiple sources available to supply values
4 for the attribute, by:

5 sending to an intermediary module a first request for a value of a first of the
6 state attributes;

7 receiving from the intermediary module a first value for the first state
8 attribute that was supplied from a first source, the first value obtained by the intermediary
9 module from the first source in response to the sent first request and sent from the
10 intermediary module in response to the sent first request;

11 sending to the intermediary module a second request for a value of the first
12 state attribute;

13 receiving from the intermediary module a second value for the first state
14 attribute that was supplied from a second source, the second value obtained by the
15 intermediary module from the second source in response to the sent second request and
16 sent from the intermediary module in response to the sent second request;

17 sending to the intermediary module a third request for a value of a second
18 of the state attributes;

19 receiving from the intermediary module a third value for the second state
20 attribute that was supplied from a third source, the third value obtained by the
21 intermediary module from the third source in response to the sent third request and sent
22 from the intermediary module in response to the sent third request; and

23 using at least one of the received values to perform processing based on the
24 modeled current state.

1 56. A computing device for providing information about a current state
2 that is modeled with multiple state attributes, each of the state attributes having multiple
3 sources available to supply values for the attribute, comprising:

4 a first module capable of sending to an intermediary module a first request
5 for a value of a first of the state attributes, of sending to the intermediary module a
6 second request for a value of the first state attribute, and of sending to the intermediary
7 module a third request for a value of a second of the state attributes;

8 a second module capable of receiving from the intermediary module a first
9 value for the first state attribute that was supplied from a first source, the first value
10 obtained by the intermediary module from the first source in response to the sent first
11 request and sent from the intermediary module in response to the sent first request, of
12 receiving from the intermediary module a second value for the first state attribute that
13 was supplied from a second source, the second value obtained by the intermediary
14 module from the second source in response to the sent second request and sent from the
15 intermediary module in response to the sent second request, and of receiving from the
16 intermediary module a third value for the second state attribute that was supplied from a
17 third source, the third value obtained by the intermediary module from the third source in
18 response to the sent third request and sent from the intermediary module in response to
19 the sent third request; and

20 a third module using at least one of the received values to perform
21 processing based on the modeled current state.

1 57. A computer-implemented method for providing information about a
2 current state that is modeled with multiple state attributes, each of the state attributes
3 having multiple sources available to supply values for the attribute, comprising:

4 sending to an intermediary module a registration message indicating an
5 ability to supply values for an indicated one of the state attributes of the modeled current
6 state; and

7 for each of multiple requests for a value of the one state attribute,

8 receiving the request from the intermediary module, the sending of the
9 request from the intermediary module based on an request received by the intermediary
10 module from a client; and

11 in response to the receiving of the request,
12 retrieving multiple pieces of input information about the modeled
13 current state,

14 generating a value for the one state attribute based at least in part
15 on the retrieved input information; and

16 sending to the intermediary module an indication of the generated
17 value so that the intermediary module can supply the generated value to the client.

1 58. The method of claim 57 including generating an uncertainty value
2 associated with accuracy of the generated value, and wherein the sending of the
3 indication of the generated value includes an indication of the generated uncertainty
4 value.

1 59. The method of claim 57 including determining an effective time at
2 which the generated value is most accurate, and wherein the sending of the indication of
3 the generated value includes an indication of the determined effective time.

1 60. The method of claim 57 including:
2 sending to the intermediary module a registration message indicating an
3 ability to supply values for another one of the state attributes;
4 generating a value for the another state attribute based at least in part on
5 received input information about the modeled current state, and
6 sending to the intermediary module an indication of the generated value for
7 the another state attribute.

1 61. The method of claim 57 wherein the state attributes represent
2 information about a user of the computer.

1 62. A computer-readable medium whose contents cause a computing
2 device to provide information about a current state that is modeled with multiple state
3 attributes, each of the state attributes having multiple sources available to supply values
4 for the attribute, by:

5 sending to an intermediary module a registration message indicating an
6 ability to supply values for an indicated one of the state attributes of the modeled current
7 state; and

8 for each of multiple requests for a value of the one state attribute,
9 receiving the request from the intermediary module, the sending of the
10 request from the intermediary module based on an request received by the intermediary
11 module from a client; and

12 in response to the receiving of the request,
13 retrieving multiple pieces of input information about the modeled
14 current state,

15 generating a value for the one state attribute based at least in part
16 on the retrieved input information; and

17 sending to the intermediary module an indication of the generated
18 value so that the intermediary module can supply the generated value to the client.

1 63. A computer system for providing information about a current state
2 that is modeled with multiple state attributes, each of the state attributes having multiple
3 sources available to supply values for the attribute, comprising:

4 a first module capable of sending to an intermediary module a registration
5 message indicating an ability to supply values for an indicated one of the state attributes
6 of the modeled current state; and

7 a second module capable of, for each of multiple requests for a value of the
8 one state attribute,

9 receiving the request from the intermediary module, the sending of the
10 request from the intermediary module based on an request received by the intermediary
11 module from a client; and
12 in response to the receiving of the request,
13 retrieving multiple pieces of input information about the modeled
14 current state,
15 generating a value for the one state attribute based at least in part
16 on the retrieved input information; and
17 sending to the intermediary module an indication of the generated
18 value so that the intermediary module can supply the generated value to the client.

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